Effects of Paddy Dusts on FVC, FEV_1 and FEV_1/FVC ratio in Male Rice Mill Workers without Protector

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Abstract:

Context: Among the global risk factors of morbidity and mortality the occupational lung diseases are becoming a great concern. Exposure to paddy dusts in the rice mills causing the workers to be associated with a long history of proliferative and fibrotic diseases in the lungs and also adverse effects on skin, nose and eyes. The aim of this study was to assess the effects of paddy dusts on FVC, FEV_1 and FEV_1 / FVC ratio of paddy dust exposed rice mill male workers specifically male workers. **Methods:** This cross sectional analytical study was conducted in the department of Physiology, Rangpur Medical College (RpMC), Rangpur from July, 2017 to June, 2018. In this study lung function was being assessed by measuring different parameters of lung volume such as FVC, FEV_1, FEV_1/FVC ratio. Reduction of these parameters from their normal range was taken into account for impairment of lung function. The study group enrolled 30 healthy male rice mill workers without protector exposed to paddy dust during working in rice mills and the control consisted of age, sex, height, weight and BMI matched 30 healthy males from surrounding community who were not exposed to paddy dust. FVC, FEV_1 and FEV_1/FVC ratio of all the subjects were measured by digital spirometer. Statistical analysis was done by independent sample 't' test which was performed by computer based software SPSS-24.0 version for windows. **Results:** The mean predicted values of FVC, FEV_1 and FEV_1/FVC ratio between the male rice mill workers without protector and control group were not significant. The mean measured value and percentage of predicted value of FVC and FEV_1 were significantly ($p< 0.05$) lower in the male rice mill workers without protector than the male control group but there were no statistically significant ($p> 0.05$) differences in mean measured value and percentage of predicted value of FEV_1/FVC ratio. **Conclusion:** Evaluation of these parameters are helpful in assessing lung function impairment in paddy dust exposed rice mill workers with implicating the importance of usage of protectors during working in the rice mills to prevent the hampering of lung function among the rice mill workers.

Indexing words: Paddy dust, Forced vital capacity (FVC), FEV_1 (Forced expiratory volume in 1 second), FEV_1/FVC ratio

Introduction:

Definite type of occupational hazards are certainly related to occupational health, which studies on all factors relating to work, working methods, condition of work and the working environment.[1] Occupational respiratory disease can be defined as an acute or chronic disorder that arises from the inhalation of airborne agents in the work place mainly organic dust.[2] The dust exposed in rice mills is a complex organic dust with varied composition including particles of husk, cuticular hair, pollen, bacteria and mucous spore.[3] Paddy dust is known to have a high silica content. The kind of exposure like paddy dust (containing biogenic silica) can cause both restrictive and obstructive type of lung diseases including such responses as extrinsic allergic alveolitis, toxic syndrome, farmer's lung, chronic bronchitis, asthma and interstitial lung diseases.[4] Decrease in various lung function parameters in paddy dust exposed workers may be due to exposure to industrial dust, poor ventilation, non use of face masks and lack of proper exhaust facility.[1] The occupational diseases depend on

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concentration, size, solubility, weight and shape of the dust particle along with the duration of exposure apart from variation in personal immunity. The Swedish National Board of occupational safety and health has prescribed the dust exposure limit of 10 mg/m^3 and 5 mg/m^3 for normal and organic dust respectively.[5] Several reports have suggested unprotected dust in agricultural work stations may lead to pulmonary fibrosis exhibiting a significant drop in FEV_1 and FVC in the workers exposed to paddy dusts.[6]

In occupational respiratory diseases, spirometry is one of the important diagnostic tool. Periodic testing by spirometer plays a significant role in detecting pulmonary diseases in its earlier stages when corrective measures are more likely to be beneficial.[7] To the best of researcher's knowledge there has not been any recent study to identify and assess the health risk of occupational health hazards and safety measures of the rice mill workers against paddy dust exposures in Bangladesh.

Thus the aim of this study was to identify and assess the occupational health hazards among paddy dust exposed workers by measuring this spirometric lung function parameters.

Methods:

This cross sectional analytical study was conducted in the department of Physiology in Rangpur Medical College from July 2017 to June 2018. Protocol of this study was approved by Ethical review committee of Rangpur Medical College. For this study 30 healthy male rice mill workers aged between 20-45 years without protector (group-A) were selected from different rice mills of different districts in Rangpur division. Age, sex and BMI matched 30 healthy subjects (group-B) from surrounding community not exposed to paddy dust were selected as control. Fasting serum glucose level, serum creatinine, serum alanine amino transferase levels were estimated in both the groups of the present study for exclusion of DM, kidney disease and liver disease. All the values of these parameters were within the normal range in both groups.

All the subjects were non obese and free from smoking, any type of chest deformities, asthma, COPD, DM, HTN, kidney diseases and any type of systemic illness. Before performing the tests, all the subjects were briefed about the nature, purpose and benefits of the study. Informed written consent of the study subjects were taken in easily understandable Bengali phrases. Detailed family and medical history were taken. All the information was recorded in a pretested data collection form. FVC, FEV_1 were measured and FEV_1/FVC ratio was automatically calculated by Autospiro (Digital Spirometer). After inputting of age, height, weight of each subject into the spirometer, the predicted value of FVC, FEV_1, FEV_1 /FVC ratio were automatically calculated by the digital spirometer. Then for measured value several forced expiratory maneuver (with two minutes interval in between each) performed by the subjects and from the values three maximum were recorded. Among these three the maximum one was selected automatically and printed out for data computation. Percentage of predicted value for each parameter was also calculated automatically by the digital spirometer. The readings were taken in standing position. Data analysis was done by using a computer based software SPSS, 24.0 versions for window. Statistical analysis was done by unpaired 't' test. p value <0.05 was accepted as level of significance.

Results:

Mean age, height, weight and body mass index were almost similar in male control and rice mill workers without protector and there were statistically no significant differences (p>0.05) between the groups.

Table 1: Mean (±SD) values of general characteristics of study subjects (n=60)

Parameters	Group A (n=30)	Group B (n=30)
Age(years)	37.27±2.490	36.83±2.350
Height(m)	1.67±0.0324	1.65±0.052
Weight(kg)	63.167±4.218	62.233±3.883
BMI(kg/m^2)	22.567±1.240	22.443±1.196

In this study there was no significant difference of mean predicted values of FVC and FEV_1 between group A and B. The mean measured value and percentage of predicted value of FVC and FEV_1 were significantly lower (p< 0.05) in group A than in group B. There were no statistically significant differences in mean predicted value, measured value and percentage of predicted value of FEV_1/FVC ratio between group A (male rice mill workers without protector) and group B (male control)).

Table 2: Showing statistical analysis of mean values of FVC, FEV_1 and FEV_1% of study subjects:

Lung function parameters	Measurements	Mean(±SD)		't' value	p value
		Group A	Group B		
FVC	Predicted value(L)	3.73(±0.399)	4.39(±0.428)	6.174	0.545^{NS}
	Measured value(L)	2.68(±0.227)	4.34(±0.447)	18.16	0.013^{S}
	Percentage of predicted value (%)	66.76(±4.59)	99.10(±3.10)	31.96	0.009^{S}
FEV_1	Predicted value(L)	3.415(±0.162)	3.628(±0.19)	4.661	0.551^{NS}
	Measured value(L)	3.145(±0.123)	3.513(±0.38)	4.703	0.002^{S}
	Percentage of predicted value (%)	66.20(±6.166)	99.31(±2.89)	26.108	0.002^{S}
FEV_1/FVC	Predicted value(L)	85.00(±1.37)	86.61(±1.77)	3.910	0.113^{NS}
	Measured value(L)	85.14(±8.79)	85.06(±2.30)	-0.062	0.950^{NS}
	Percentage of predicted value (%)	99.36(±10.47)	98.34(±1.67)	-0.680	0.498^{NS}

Discussion:

In the present study, mean measured values of FVC, FEV_1 and FEV_1/FVC ratio in healthy control group were within normal range and also similar reported by other investigators from different countries.[4,8] There were no statistically significant differences of mean predicted values of FVC, FEV_1 and FEV_1/FVC ratio between the groups. However no published data of these study parameters in paddy dust exposed workers are available for comparison from our country. The observations in this study indicated that although obstructive pulmonary impairment was more frequent, both types of changes were present in rice mill workers. Due to paddy dust exposure fall in FVC indicated restrictive lung changes and fall in FEV_1 indicated obstructive lung changes.[9] Both these decreases were statistically significant than the control subjects. Mean measured and percentage of predicted values of FVC of male rice mill workers without protector were significantly lower than the control males which findings were similar to the studies by other investigators also.[3,4,6,9,10-12] Some previous studies also showed significant decrease in mean measured and percentage of predicted values of FEV_1 in male rice mill workers without protector in comparison to the control as collaborated by this study.[3,4,6,9,11-13] No significant ($p>0.05$) change in FEV_1/FVC ratio between both the groups were found in this study which is further supported by similar findings observed by Itagi et al[9], Musa et al[10] and Wickramage et al[12]. The decrease in FVC might be due to much more changes to the bronchi and elastic components of lungs resulting in restrictive type of lung impairment. Decrease in FEV_1 showed that exposure to dust caused early obstructive pulmonary impairment which further increased with increase in numbers of years of exposure.[14] Though various suggestions made by different investigators as mentioned earlier as possible causes of lung functions impairment but it is difficult to comment on exact mechanisms in this type of study. From the discussions of researchers it covers a few way in this regard of mechanism; macrophages and mucocilliary system were responsible for the clearance of dust particles from the lungs. Inhalation of paddy dusts over long time might lower the ability of macrophages to eliminate particles and impaired the activity of cilia lining the bronchi with decreased rate of airway clearance. This might result in penetration of the dust particles into the interstitium. As a result of subsequent inflammatory responses, hypertrophy and hyperplasia of mucous glands occurred which were causing progressive impairment of lung functions with increased work of breathing resulting in lower values of FVC, FEV_1.[15] Another mechanism responsible for this inflammatory reaction was mentioned by the researchers supposed to be the chronic allergic effects of paddy dust which produced sufficient IgE in the body. IgE bound with the mast cell and basophil causing release of agents including SRSA, protease, histamine, neutrophil and eosinophil chemotactic factor at alveolar or bronchiolar site. Such type of immunologically induced inflammation due to inhalational exposure to a large variety of antigens caused increasing lung parenchymal and airway

resistance secondary to tissue damages and inflammation mediated fibrotic changes.[15] In this study it is suggested that repeated microinsults to the lungs on each exposure to the toxic component of paddy dusts would have damaging effects, thus a long time exposure to paddy dusts cause progressive impairment of lung functions and adversely affects the parameters such as FVC, FEV_1. There is no effects on FEV_1/FVC ratio because may be due to proportionately decrease in FEV_1 and FVC in male experimental group without protector in comparison to the control subjects.

Conclusion:

From this study, it can be concluded that rice mill workers without protector exposed to paddy dust usually suffer from impaired lung function. So it is suggested that the rice mill workers and the rice milling authority should implement appropriate measures like regular use of respirator and other protective measures like face masks, aprons, goggles, hand gloves and making the use of these protectors mandatory during working, maintenance of proper ventilation, raising awareness about the occupational health hazards among the workers for prevention of developing impaired lung functions.

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